

Recipe for chocolate chip cookies:

4 cups flour + 2 cups choc. chips + 2 eggs + 2
tablespoons baking powder + 1 teaspoon vanilla
= 3 dozen cookies

What if I only have 1.4 cups of flour? How many
cookies can I make?

Look at the original recipe: what's the ratio
between cookies (what I need) and flour
(what I have)?

In the recipe, the ratio between cookies and flour is:

3 dozen cookies

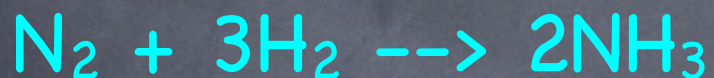
4 cups flour

So, I can take the flour I have and multiply it by the ratio above:

$$1.4 \text{ cups flour} \times \frac{3 \text{ dozen cookies}}{4 \text{ cups flour}} = 1.05 \text{ dozen cookies}$$

RECIPES IN CHEMISTRY:

Writing and using mole ratios:



"1 mol of nitrogen reacts with 3 mol of hydrogen to form 2 mol ammonia."

Mole ratio: tells the ratio between 2 substances in a balanced chemical equation.

1 mol N₂

3 mol H₂

2 mol NH₃

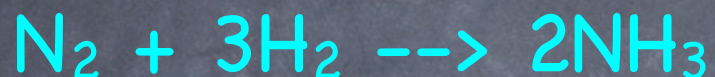
1 mol N₂

3 mol H₂

2 mol NH₃

Using mole ratios to solve problems:

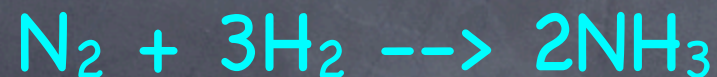
How many moles of ammonia are produced when 0.60 mol of nitrogen reacts with hydrogen?



Step 1: identify your known and unknown:

Known: 0.60 mol N_2

Unknown: ? mol NH_3

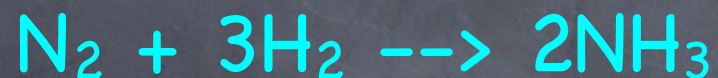


Step 2: Use the unknown and known in the equation to develop a mole ratio:

$$\frac{2 \text{ mol NH}_3}{1 \text{ mol N}_2} \quad \begin{array}{l} \text{(unknown from equation)} \\ \text{(known from equation)} \end{array}$$

Step 3: multiply the known by the mole ratio:

$$0.60 \text{ mol N}_2 \times \frac{2 \text{ mol NH}_3}{1 \text{ mol N}_2} = 1.2 \text{ mol NH}_3$$



How many mol of hydrogen reacts with 2.4 mol nitrogen to form ammonia?

Known: 2.4 mol N_2

Unknown: ? mol H_2

Mole ratio: $\frac{3 \text{ mol H}_2}{1 \text{ mol N}_2}$ (unknown from equation)
(known from equation)

$$2.4 \text{ mol N}_2 \times \frac{3 \text{ mol H}_2}{1 \text{ mol N}_2} = 7.2 \text{ mol H}_2$$



How many mol of aluminum are needed to form 7.8 mol aluminum oxide?

Known: 7.8 mol Al_2O_3

Unknown: ? mol Al

Mole ratio: $\frac{4 \text{ mol Al}}{2 \text{ mol Al}_2\text{O}_3}$ $\frac{\text{(unknown from equation)}}{\text{(known from equation)}}$

$$7.8 \text{ mol Al}_2\text{O}_3 \times \frac{4 \text{ mol Al}}{2 \text{ mol Al}_2\text{O}_3} = 15.6 \text{ mol Al}$$

STOICHIOMETRY-Using chemical equations to determine quantities

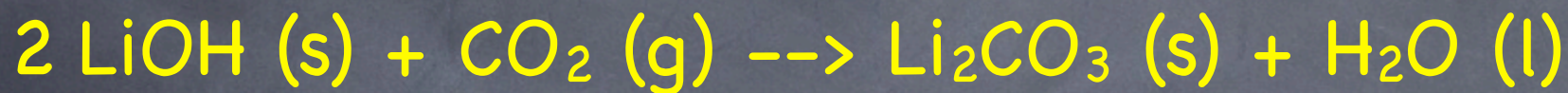
Solid lithium hydroxide is used in space vehicles to remove exhaled carbon dioxide. The lithium hydroxide reacts with gaseous carbon dioxide to form solid lithium carbonate and liquid water. How many grams of carbon dioxide can be absorbed by 1.00g of lithium hydroxide?

How do we solve this problem?

Step 1: Write a balanced chemical equation:



Understand that each coefficient represents the number of moles of each substance.



Pay attention to the substance and units asked for in the problem.....we need grams of CO_2 .

Step 2: Find the ratio between the unknown substance and the known substance in the problem:

The mole ratio of $\frac{\text{unknown}}{\text{known}} = \frac{\text{CO}_2}{\text{LiOH}}$

= $\frac{1 \text{ mol CO}_2}{2 \text{ mol LiOH}}$

Step 3: Write down the quantity and substance you are starting with in the problem and convert to moles, and multiply by the mole ratio.

$$1.00 \text{ g LiOH} \times \frac{1 \text{ mol}}{23.9 \text{ g}} \times \frac{1 \text{ mol CO}_2}{2 \text{ mol LiOH}} =$$

But we need grams of CO_2 , so we must convert moles of CO_2 to grams:

$$1.00 \text{ g LiOH} \times \frac{1 \text{ mol}}{23.9 \text{ g}} \times \frac{1 \text{ mol CO}_2}{2 \text{ mol LiOH}} \times \frac{44.0 \text{ g}}{1 \text{ mol}} =$$

$$0.92 \text{ g CO}_2$$

Mathematically, the problem is:

$$1.00/23.9/2 \times 44.0 = 0.92$$

The combustion of carbon monoxide is:



How many liters of oxygen are required to burn 7.84 L of carbon monoxide?

$$7.84\text{L CO} \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{1 \text{ mol O}_2}{2 \text{ mol CO}} \times \frac{22.4\text{L}}{1 \text{ mol}} =$$

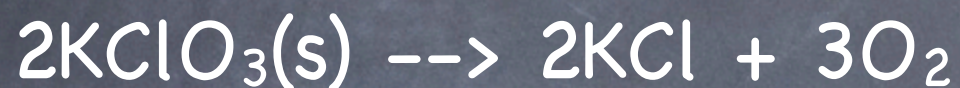
3.92 L O₂

Which factors above canceled out?

In a volume-volume problem, 22.4L/mol factors out.

The coefficients in an equation also indicate # of liters.

How many molecules of oxygen are produced by the decomposition of 11.53 g of potassium chlorate?



$$11.53 \text{ g KClO}_3 \times \frac{1 \text{ mol}}{122.6 \text{ g}} \times \frac{3 \text{ mol O}_2}{2 \text{ mol KClO}_3} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}}$$

$$= 8.5 \times 10^{22} \text{ molecules O}_2$$

Astronauts depend on these CO₂ "scrubbers" to clean the air they breathe. If the average person exhales 432 L of CO₂ at STP, how many grams of LiOH is needed per person in the scrubbers?



Known: 432 L CO₂

Unknown: grams LiOH

$$432 \text{ L CO}_2 \times \frac{1 \text{ mol}}{22.4 \text{ L}} \times \frac{2 \text{ mol LiOH}}{1 \text{ mol CO}_2} \times \frac{23.9 \text{ g}}{1 \text{ mol}} =$$

921.9 g LiOH

Steps in solving stoichiometry problems:

1. Identify known and unknown.
2. Convert known quantity to moles.
3. Multiply by the mole ratio.

moles of unknown/moles of known

4. Convert to needed units by using conversion factors.

Complete problems #39–44 on p. 379. Do your work here:

